MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

TML2221 – MACHINE LEARNING
(All Sections/Groups)

10 March 2020
09:00AM – 11:00AM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 5 pages (including cover page) with 4 structured questions.

2. Answer ALL questions. The distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

Question 1

(a) The Turing test, developed by Alan Turing in 1950, is a test of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human. Briefly describe how machine's intelligence is tested using Turing Test.

(2 marks)

(b) Briefly explain training set, validation set, and testing set.

(3 marks)

(c) Given the following 3 data of final exam marks based on the number of self-study hours:

Number of self-study hours (x_1)	Final exam marks (y)
40	92
25	65
18	56

Using mean squared error, which of the following linear regression models is the best model?

  i. $w_0 = 22, w_1 = 2$
 ii. $w_0 = 20, w_1 = 0.8$

(5 marks)

Continued......

Question 2

(a) Given the following 3 data of final exam grade based on the number of lecture hours:

Number of lecture hours (x_1)	Final exam grade (y)
40	Pass (1)
15	Fail (0)
35	Pass (1)

Given threshold = 0.5, compute the cost of the following logistic regression models. Which one is the best model? *[Use 8 decimal places in the calculation]*

  i. $w_0 = 3, w_1 = 0.01$
 ii. $w_0 = 2, w_1 = 0.05$

(5 marks)

(b) Given the following confusion matrix:

True Positives (TPs): 50	False Positives (FPs): 4
False Negatives (FNs): 6	True Negatives (TNs): 40

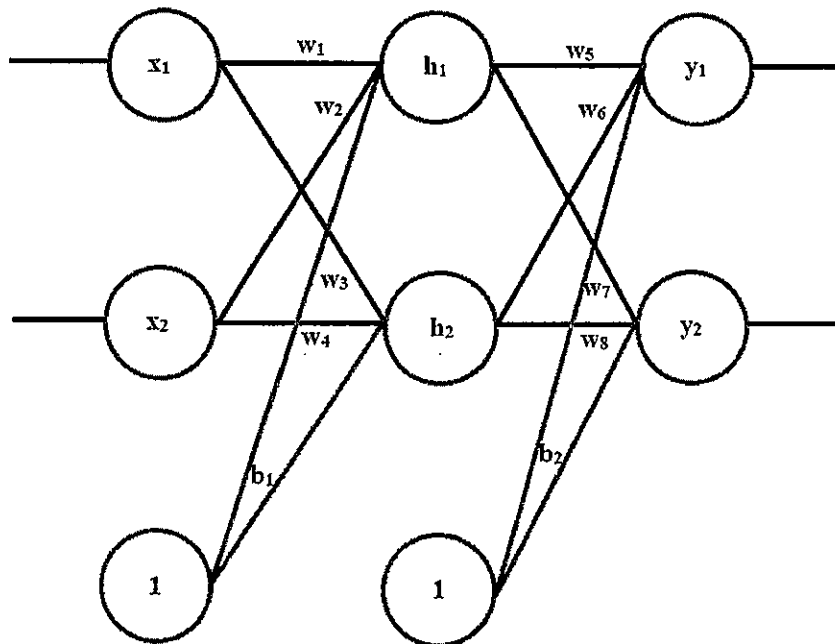Calculate the accuracy, precision, and recall.

(3 marks)

(c) What is the main limitation of Perceptron? Give one of the possible solutions to solve this limitation.

(2 marks)

Continued......

Question 3

The architecture of the Multilayer Perceptron Neural Network is given as below:

Assume that the neurons are using *Sigmoid* activation function, and learning rate, η, is set to 0.9. The weights of the neural network $[w_1\ w_2\ w_3\ w_4\ w_5\ w_6\ w_7\ w_8]$ is set to $[0.32\ 0.15\ 0.36\ 0.22\ 0.64\ 0.08\ 0.28\ 0.27]$, and the bias $[b_1\ b_2]$ is set to $[0.36\ 0.24]$. Given an input vector $[x_1\ x_2] = [0.38\ 0.52]$, and the target output $[y_1\ y_2] = [0.60\ 0.40]$, compute the following: *[Use 8 decimal places in the calculation]*

(a) Perform a forward pass on the neural network.   (4 marks)
(b) Compute the error occurred at $[y_1\ y_2]$ and the total error at output layer.   (2 marks)
(c) Perform a backward pass to update the weights of the neural network.   (4 marks)

Continued......

Question 4

(a) In order to build an optimum model, we need to find a balance between bias and variance that minimizes the total error. Illustrate the bias-variance tradeoff. Then, describe the error due to bias and variance.

(3 marks)

(b) Briefly explain autoencoder neural network.

(2 marks)

(c) Given the architecture of a Convolutional Neural Network as below:

	Activation Shape	Activation Size	Number of parameters
Input layer	(32, 32, 3)	3072	
Convolution 1 (filter size = 5, Stride = 1)	(28, 28, 8)	6272	
Max Pooling (Window size = 2, Stride = 2)	(14, 14, 8)	1568	
Convolution 2 (filter size = 5, Stride = 1)	(10, 10, 16)	1600	
Max Pooling (Window size = 2, Stride = 2)	(5, 5, 16)	400	
Fully connected layer 3	(120, 1)	120	
Fully connected layer 4	(84, 1)	84	
Softmax	(10, 1)	10	
Total parameters			

Assuming that a bias unit is added to each of the filters and fully connected layers, calculate the number of parameters of each row in the above table.

(5 marks)

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